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situated that one seems to overlap the other. The present drainage from one turns sharply and passes through the other. The slope of the latter is steeper than the slope of the former, and the suggestion arises that the latter encroached upon the field of the former and effected a capture of its drainage.

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A RÉSUMÉ OF THE GEOGRAPHICAL DISTRIBUTION OF THE DISCOGLOSSOID TOADS IN THE LIGHT OF ANCIENT LAND CONNECTIONS.[*]

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The discoglossoid toads form a small, compact group of five recent genera remarkable for their primitive structure and for their extraordinarily disconnected distribution. One genus, *Liopelma*, is the only batrachian found in New Zealand. Another genus,

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[*] A paper read before the Association of American Geographers in Philadelphia, December 29, 1904.

Ascaphus, is only known from a single specimen obtained a few years ago in the State of Washington not far from the Pacific Coast. The three other genera are inhabitants of the Old World: *Discoglossus*, with one recent species occurring in western North Africa, the western Mediterranean islands and the Pyrenean peninsula; *Alytes*, the celebrated midwife-toad, with two species, one of which is confined to the latter peninsula, while the other extends also through France and western Germany; finally *Bombina*, the bell-toad, with three species, one occupying the Balkan peninsula, the Italian peninsula, and the adjacent mountain regions of Central Europe, extending westward into France, though without reaching Bretagne or the Pyrenees, the other occupying the lowlands to the east and north into Russia, while the third is located thousands of miles away on the opposite side of the Eurasian continent—viz., in north-eastern China, Korea, and the Ussuri country.

This unique and disconnected distribution points to a great antiquity of these animals, and promises to shed some light upon the problem of ancient land connections, as the batrachians, more than any other class of vertebrates, require continuous land for their dispersal.

All indications point towards the country southwest of the Himalayas as the original centre of the radiation of the discoglossoid toads, as well as of their near relations the pelodytoid toads. The former are not now found in this region; but that fact weighs but little in view of *Ascaphus* having remained unknown on this continent till 1899, and thus far known only from a single specimen. The absence of paleontologic evidence is also insignificant when it is remembered that only unidentifiable fragments of toad-like animals have been found on this continent from Jurassic and Tertiary deposits.

The significant fact is the occurrence of *Liopelma* in New Zealand; and as the latter archipelago has not been connected with the great continental landmarks since the end of the Cretaceous, that batrachian must have reached those Antipodal islands before that time. The connection with the Sino-Australian continent must have been an eastern one, as various facts militate against Australia proper having been involved.

There is, then, no difficulty in assuming that the ancestor of the North American *Ascaphus* reached the Pacific Coast of North America during the Upper Cretaceous over the landbridge which must then have connected eastern Asia and the western portion of our continent—a bridge the existence of which is attested by so many facts, and now so universally admitted that it does not detain us here.

The discoglossoids must also have reached Europe shortly after, as we find them recorded (*Discoglossus troschelii*) already in the European Lower Miocene, and it is even possible that they may have been there as early as the Upper Eocene.

If the geologists are right, who insist on the existence of a vast Mediterranean Ocean in the Lower Tertiary separating absolutely Europe from Eastern Asia, none of these early discoglossoids can have reached Western Europe from the East. A direct land connection with North America at that period meets with less difficulty and seems altogether probable. In that case the ancestors of *Discoglossus* and *Alytes* may with certainty be regarded as having come to Europe from America, in favour of which contention their Western distribution may also be cited.

The case of *Bombina* is less easily disposed of, due to the occurrence of one species at the extreme eastern end of Asia separated by thousands of miles from the other two. Of the various theories which might be advanced in order to explain this distribution it seems most reasonable at present to select the one which presupposes a comparatively late immigration of this genus from south-eastern Asia into Europe after a late Miocene land connection had been established—a theory which would account for the failure of these toads to reach Spain on the one side and Japan on the other. This assumption rests upon the negative fact that *Bombina* has not been found fossil in Europe below the Upper Miocene. Should it be found lower, we will have to assume for it an American route, or else that the separation of Europe from Eastern Asia by the Mediterranean Ocean was not so complete or of so long duration as has been generally asserted.

The main significance of the above review is that it shows the discoglossoid toads to conform in all essential points to the ancient land connections sketched so admirably by Dr. Ortmann about two years ago, in his paper on the geographical distribution of the decapod crustaceans. The distribution of these toads—at first sight so extraordinary and puzzling—becomes easy of explanation if the distribution of land and water in time and space has been as suggested to him by the range of the decapods.